MACHINE LEARNING

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HOMEWORK-3

1) $f(x) = 5(x+47)^2$

$f'(x) = \frac{df}{dx} = 5 \times 2 \times (x+47) \times 1 = 10(x+47)$

$f'(x) = 10x + 470$

2) $f(x) = 3x^3 + 15x^2$

$f'(x) = 9x^2 + 30x$

solving for $f'(x) = 0$ to get critical points

$9x^2 + 30x = 0$

$x(9x + 30) = 0$

$3x(3x + 10) = 0$

$x(3x+10) = \frac{0}{3} = 0$

$x = 0$ or $x = \frac{-10}{3}$ are the critical points

$f''(x) = 18x + 30$

$f''(0) = 18(0) + 30 = 30 > 0$

$x = 0$ is the local minimum

$f''\left(\frac{-10}{3}\right) = \cancel{18}^{6} \times \frac{-10}{\cancel{3}} + 30 = -60 + 30 = -30$

$f''\left(\frac{-10}{3}\right) < 0$

$x = \frac{-10}{3}$ is the local maximum

$\therefore$ Maximum value for $f(x) =$

$$f\left(\frac{-10}{3}\right) =$$

$$f\left(\frac{-10}{3}\right) = 3 \times \left(\frac{-10}{3}\right)^3 + 15 \times \left(\frac{-10}{3}\right)^2$$

$$= \cancel{3} \times \frac{-1000}{\cancel{27}_{9}} + \cancel{15}^{5} \times \frac{100}{\cancel{9}_{3}}$$

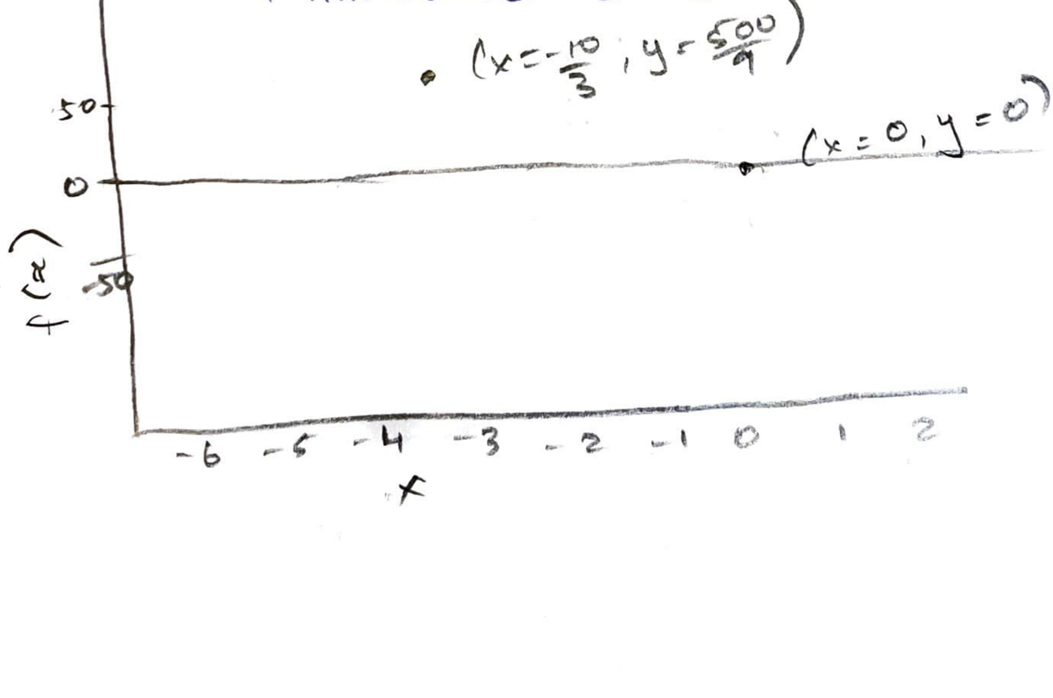
$$= \frac{-1000}{9} + \frac{1500}{9}$$

$$\left.\begin{array}{l}\text{Maximum}\\ \text{value}\end{array}\right\} = \frac{500}{9}$$

Minimum value for $f(x) = f(0)$

$$= 3 \times 0^3 + 15 \times 0^2$$

Min. value $= 0$



3) $f(x,y) = 3x + 4y$

$$\frac{\partial f}{\partial x} = 3 \quad (y \text{ is considered a constant})$$

$$\frac{\partial f}{\partial y} = 4 \quad (x \text{ is considered a constant})$$

4) $f(x,y) = xy^3 + x^2y^2$

$$\frac{\partial f}{\partial x} = y^3 + 2xy^2$$

$$\frac{\partial f}{\partial y} = 3xy^2 + 2x^2y$$

5) $f(x,y) = x^3y + e^x$

$$\frac{\partial f}{\partial x} = 3x^2y + e^x$$

$$\frac{\partial f}{\partial y} = x^3$$

6) $f(x,y) = xe^{2x+3y}$

$$\frac{\partial f}{\partial x} = e^{2x+3y} + xe^{2x+3y} \times 2$$

$$= e^{2x+3y}[1 + 2x]$$

$$\frac{\partial f}{\partial y} = x \times e^{2x+3y} \times 3 = 3xe^{2x+3y}$$

7) $$J(w_0, w_1) = \frac{1}{2m}\sum_{i=1}^{m}(w_0 + w_1 x_i - y_i)^2$$

$$\frac{\partial J}{\partial w_0} = \frac{1}{\cancel{2}m}\sum_{i=1}^{m} \cancel{2} \times (w_0 + w_1 x_i - y_i)$$

$$\frac{\partial J}{\partial w_0} = \frac{1}{m}\sum_{i=1}^{m} w_0 + w_1 x_i - y_i$$

$$\frac{\partial J}{\partial w_1} = \frac{1}{\cancel{2}m}\sum_{i=1}^{m} \cancel{2}(w_0 + w_1 x_i - y_i)\, x_i$$

$$= \frac{1}{m}\sum_{i=1}^{m} (w_0 + w_1 x_i - y_i)\, x_i$$

8) $$f(x) = \frac{1}{1+e^{-x}}$$

$$\frac{df}{dx} = \frac{-1}{(1+e^{-x})^2} \times (-e^{-x})$$

$$\frac{df}{dx} = \frac{e^{-x}}{(1+e^{-x})^2}$$